HIGH-SIDE POWER DISTRIBUTION SWITCH WITH ENABLE

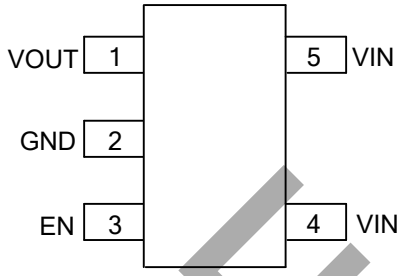
Description

The AP2821 is an integrated high-side power switch that consists of TTL compatible enables input, a charge pump, and n-channel MOSFET. The switch's low $R_{DS(ON)}$, 120mΩ, meets USB voltage drop requirements. It includes soft-start to limit inrush current, overcurrent protection with fold-back, and thermal shutdown to avoid switch failure during hot plug-in. Undervoltage lockout (UVLO) function is used to ensure the device remains off unless there is a valid input voltage present. And no reverse current when power off, with shutdown pull-low resistor to discharge the output capacitor when EN is disabled.

The AP2821 is available in standard package of SOT-23-5.

Pin Assignments

(Top View)



SOT-23-5

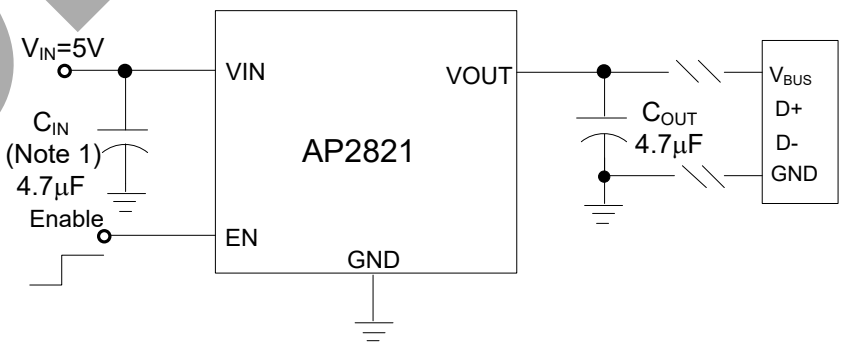
Features

- Low MOSFET On-Resistance: 120mΩ@V_{IN} = 5.0V
- Compliant to USB Specifications
- Operating Voltage Range: 2.7V to 5.5V
- Low Supply Current: 35μA (typ)
- Low Shutdown Current: < 1μA
- Current Limit with Foldback: 2A
- Undervoltage Lockout
- Soft Startup
- Overcurrent Protection
- Overtemperature Protection
- Load Short Protection with Foldback
- No Reverse Current when Power Off
- Pass System ESD: IEC61000-4-2
  ±16kV (Air Discharge) and ±8kV (Contact Discharge) on USB Connector
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative.**
  https://www.diodes.com/quality/product-definitions/

Applications

- USB power management
- USB bus/self-powered hubs
- Hot-plug power supplies
- Battery-charger circuits
- Notebooks, motherboard PCs

Typical Applications Circuit

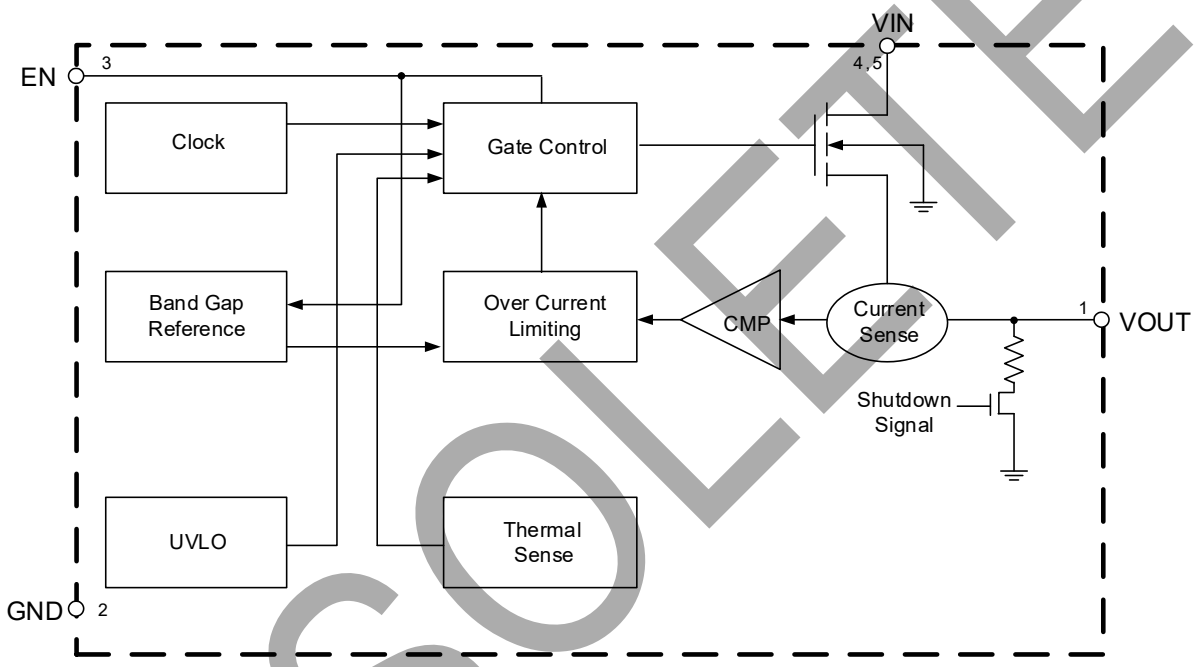


Note: 1. 4.7μF input capacitor is enough in most application cases. If the PCB trace of power rail to V_{IN} is long, larger input capacitor is necessary.

Pin Descriptions

Pin Number	Pin Name	Descriptions
1	VOUT	Switch Output Voltage
2	GND	Ground
3	EN	Chip Enable Control Input, Active High
4, 5	VIN	Supply Input Pin

Functional Block Diagram



Absolute Maximum Ratings (Note 2)

Symbol	Parameter	Rating	Unit
V_{IN}	Power Supply Voltage	6.0	V
T_J	Operating Junction Temperature Range	+150	°C
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_{LEAD}	Lead Temperature (Soldering, 10 Seconds)	+260	°C
θ_{JA}	Thermal Resistance (Junction to Ambient)	235	°C/W
—	ESD (Machine Model)	200	V
—	ESD (Human Body Model)	2000	V

Note: 2. Stresses greater than those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to *Absolute Maximum Ratings* for extended periods can affect device reliability.

Recommended Operating Conditions

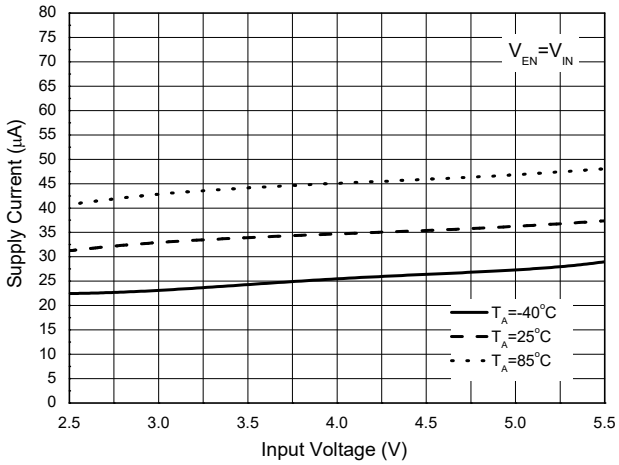
Symbol	Parameter	Min	Max	Unit
V_{IN}	Supply Voltage	2.7	5.5	V
T_A	Ambient Operation Temperature Range	-40	+85	°C

Electrical Characteristics (V_{IN} = 5.0V, C_{IN} = 4.7µF, C_{OUT} = 4.7µF, Typical T_A = +25°C, unless otherwise specified.)

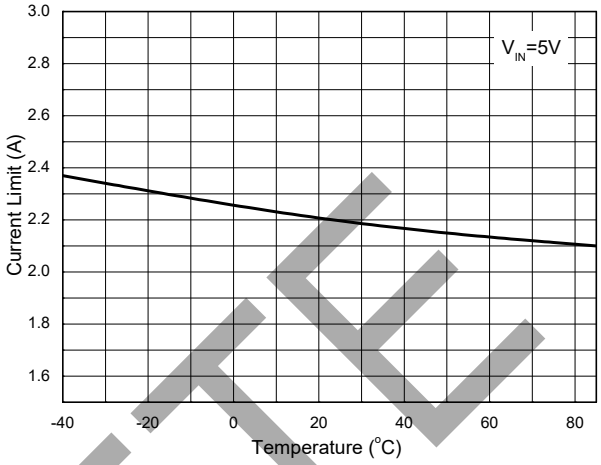
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range	—	2.7	—	5.5	V
$R_{DS(ON)}$	Switch On Resistance	V_{IN} = 5V, I_{OUT} = 0.5A	—	120	140	mΩ
I_{LIMIT}	Current Limit	V_{OUT} = 4.0V	1.5	2.0	2.8	A
I_{SUPPLY}	Supply Current	V_{IN} = 5V, R_{LOAD} Open	—	35	65	µA
I_{SHORT}	Foldback Short Current	V_{OUT} = 0	—	1.5	—	A
$I_{SHUTDOWN}$	Shutdown Supply Current	V_{EN} = 0, Shutdown Mode	—	0.1	1	µA
$I_{LEAKAGE}$	Output Leakage Current	V_{EN} = 0, V_{OUT} = 0	—	0.1	1	µA
V_{ENH}	Enable High Voltage	Enable Logic High	2.0	—	6.0	V
V_{ENL}	Enable Low Voltage	Enable Logic Low	0	—	1.2	V
I_{EN}	Enable Pin Input Current	Force 0V to 5.0V at EN Pin	0	—	1.0	µA
V_{UVLO}	Undervoltage Lockout Threshold Voltage	V_{IN} Increasing from 0	2.2	2.5	2.7	V
V_{UVLOHY}	Undervoltage Hysteresis	—	—	0.2	—	V
$I_{REVERSE}$	Reverse Current	V_{EN} = 0, V_{OUT} > V_{IN}	—	0.1	1.0	µA
$R_{DISCHARGE}$	Shutdown Pull Low Resistance	V_{EN} is disable	—	100	250	Ω
t_{ON}	Output Turn-On Time	From Enable Active to 90% of Output, R_L = 10Ω	—	1.9	—	ms
T_{OTSD}	Thermal Shutdown Temperature	—	—	+145	—	°C
T_{HYOTSD}	Thermal Shutdown Hysteresis	—	—	+20	—	
θ_{JC}	Thermal Resistance (Junction to Case)	—	—	70	—	°C/W

Performance Characteristics

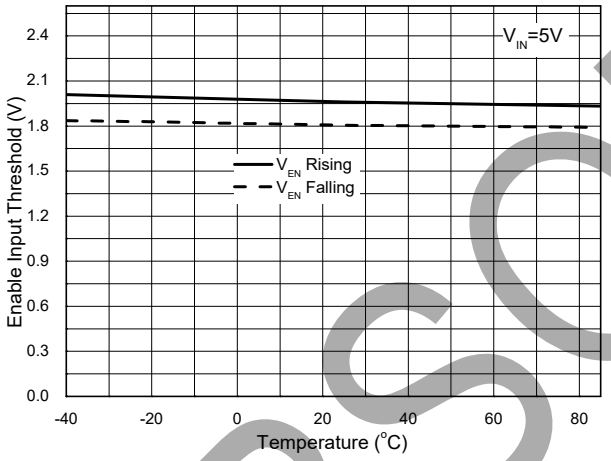
Supply Current vs. Input Voltage



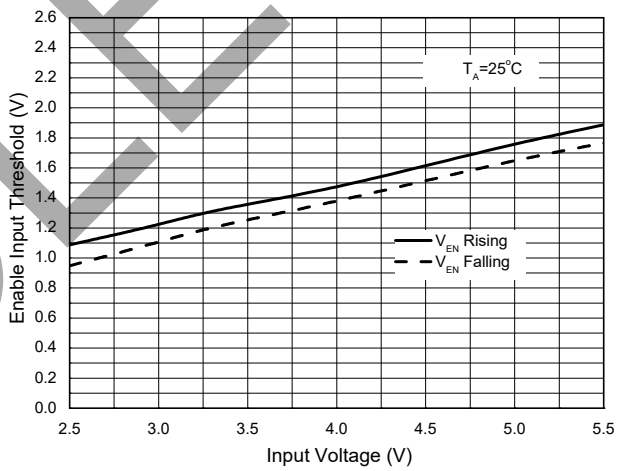
Current Limit vs. Temperature



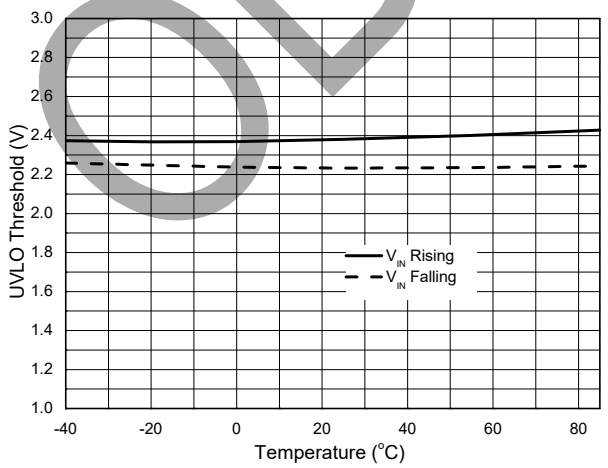
Enable Input Threshold vs. Temperature



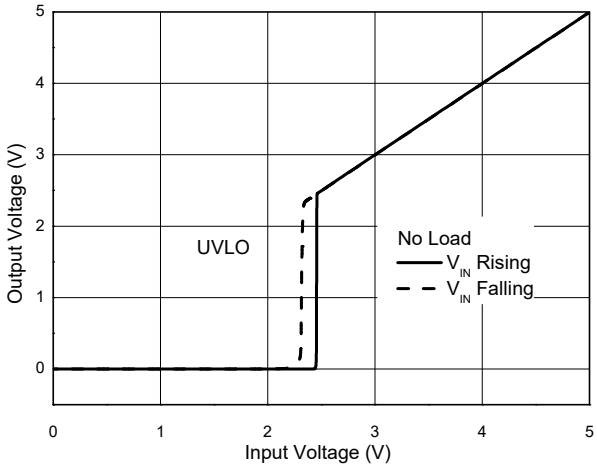
Enable Input Threshold vs. Input Voltage



UVLO Threshold Voltage vs. Temperature

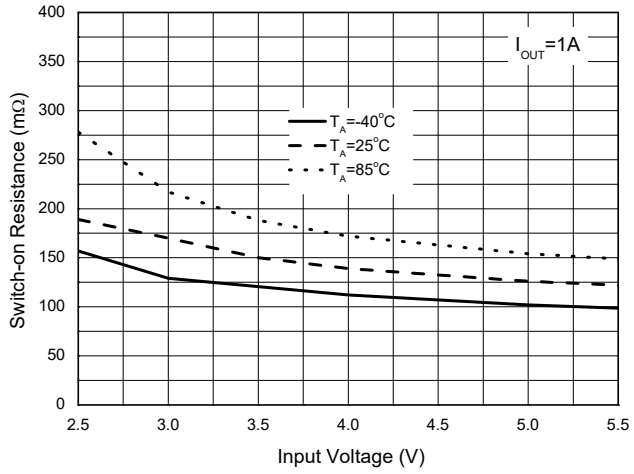


UVLO Function

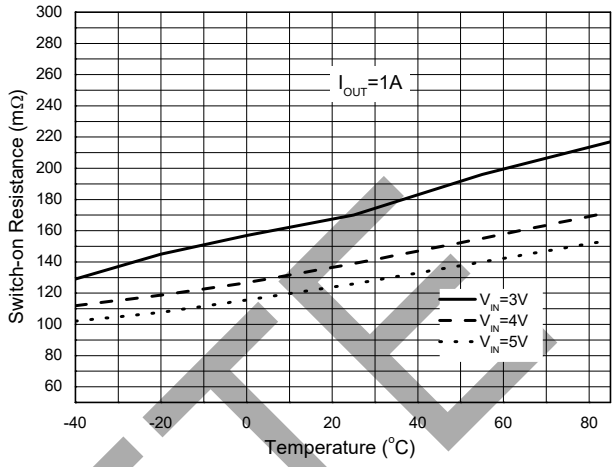


Performance Characteristics (continued)

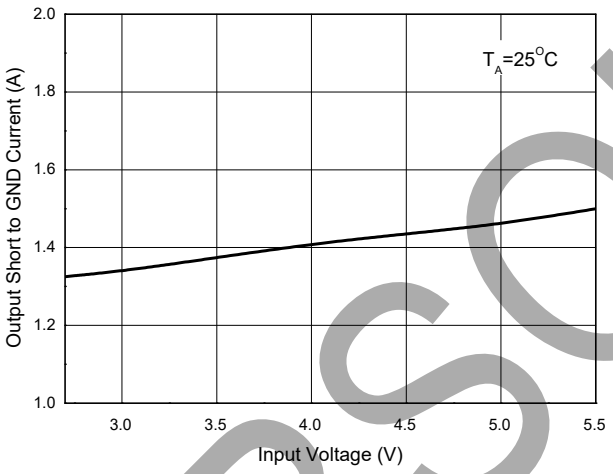
Switch-On Resistance vs. Input Voltage



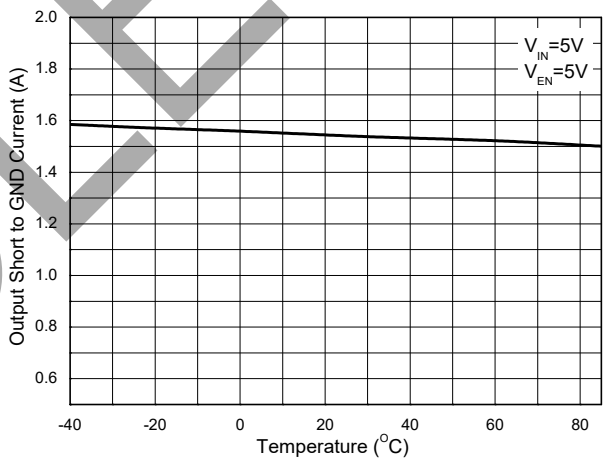
Switch-On Resistance vs. Temperature



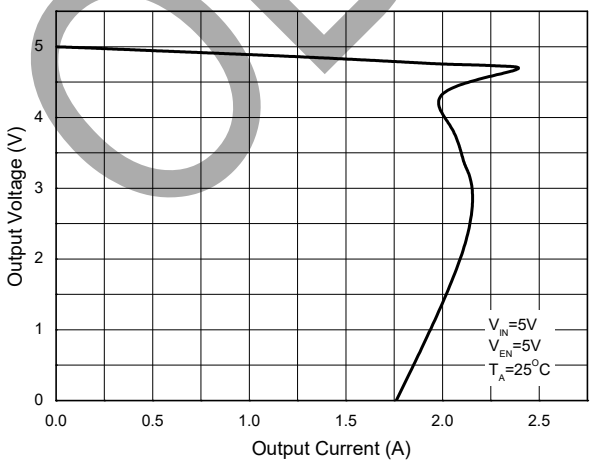
Output Short to GND Current vs. Input Voltage



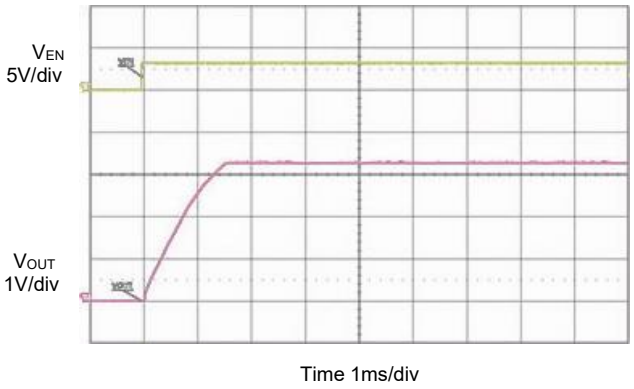
Output Short to GND Current vs. Temperature



Output Voltage vs. Output Current

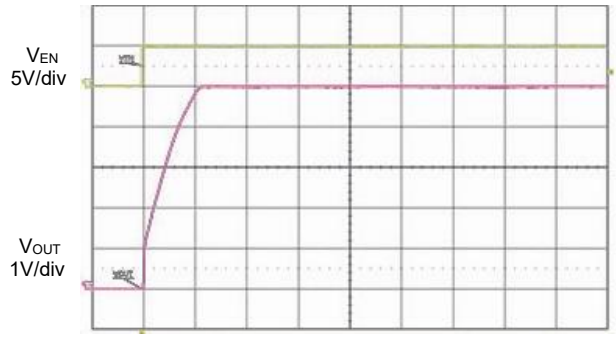


Switch Turn-On and Rise Time (V_{IN}=3.3V, C_{OUT}=4.7µF, No Load)



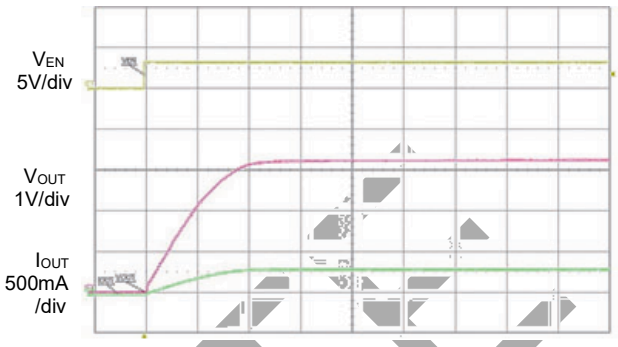
Performance Characteristics (continued)

Switch Turn-On and Rise Time
(V_{IN}=5.0V, C_{OUT}=4.7μF, No Load)



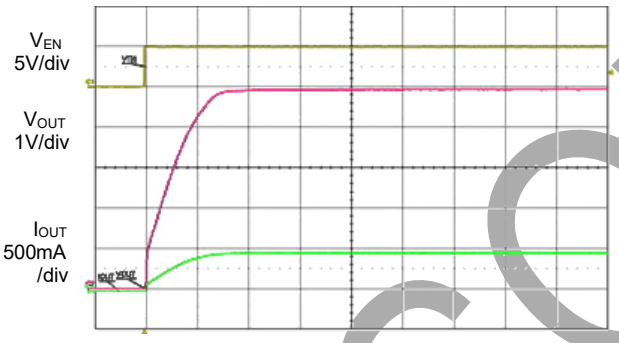
Time 1ms/div

Switch Turn-On and Rise Time
(V_{IN}=3.3V, C_{OUT}=4.7μF, R_L=10Ω)



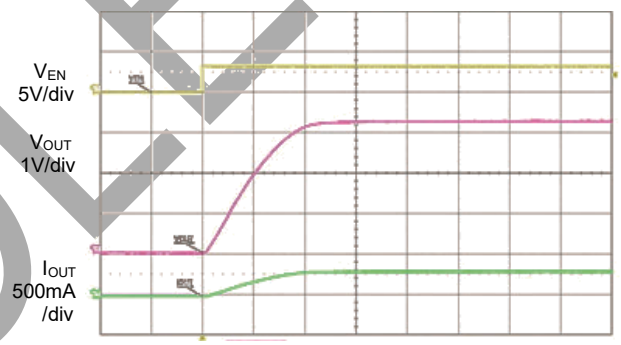
Time 1ms/div

Switch Turn-On and Rise Time
(V_{IN}=5.0V, C_{OUT}=4.7μF, R_L=10Ω)



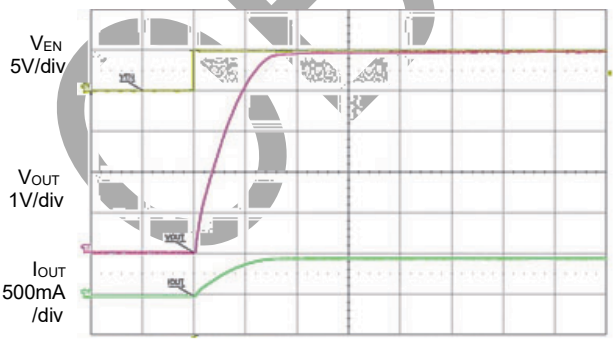
Time 1ms/div

Switch Turn-On and Rise Time
(V_{IN}=3.3V, C_{OUT}=100μF, R_L=10Ω)



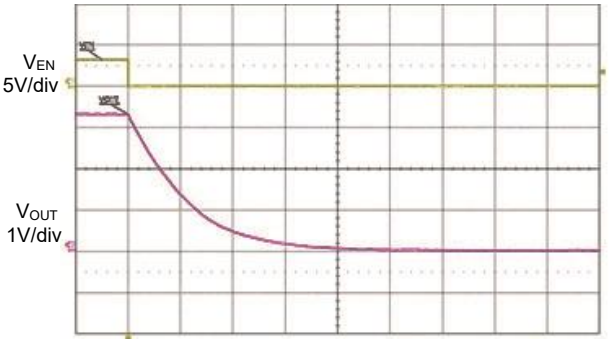
Time 1ms/div

Switch Turn-On and Rise Time
(V_{IN}=5.0V, C_{OUT}=100μF, R_L=10Ω)



Time 1ms/div

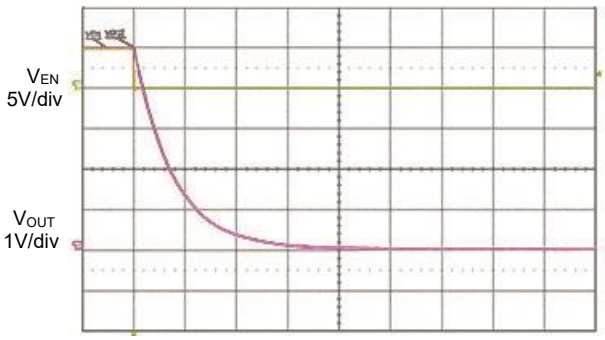
Switch Turn-Off and Fall Time
(V_{IN}=3.3V, C_{OUT}=4.7μF, No Load)



Time 1ms/div

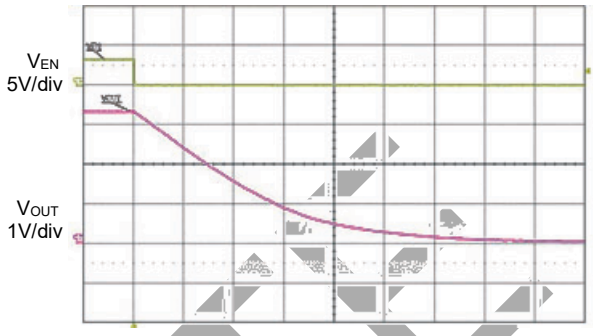
Performance Characteristics (continued)

Switch Turn-Off and Fall Time
(V_{IN}=5.0V, C_{OUT}=4.7μF, No Load)



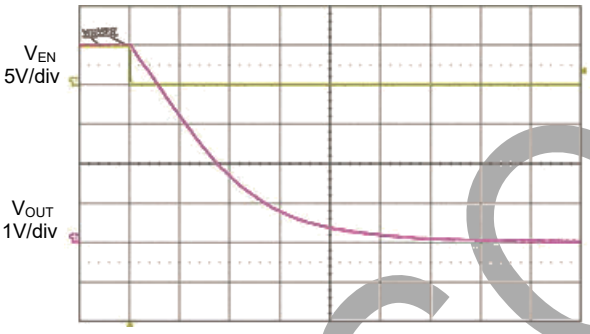
Time 1ms/div

Switch Turn-Off and Fall Time
(V_{IN}=3.3V, C_{OUT}=100μF, No Load)



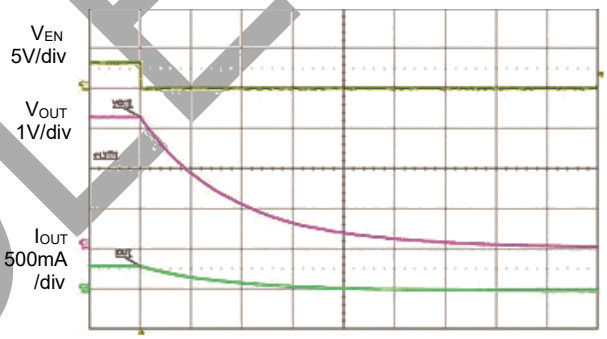
Time 10ms/div

Switch Turn-Off and Fall Time
(V_{IN}=5.0V, C_{OUT}=100μF, No Load)



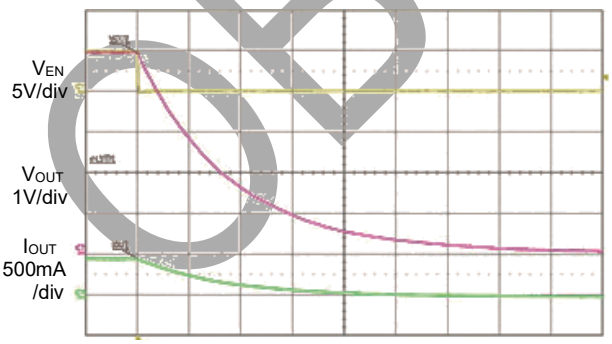
Time 10ms/div

Switch Turn-Off and Fall Time
(V_{IN}=3.3V, C_{OUT}=100μF, R_L=10Ω)



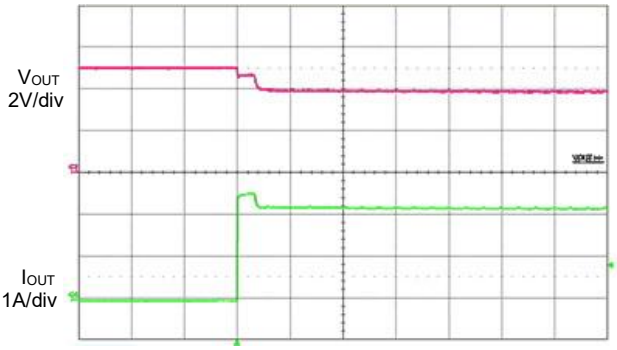
Time 500μs/div

Switch Turn-Off and Fall Time
(V_{IN}=5.0V, C_{OUT}=100μF, R_L=10Ω)



Time 500μs/div

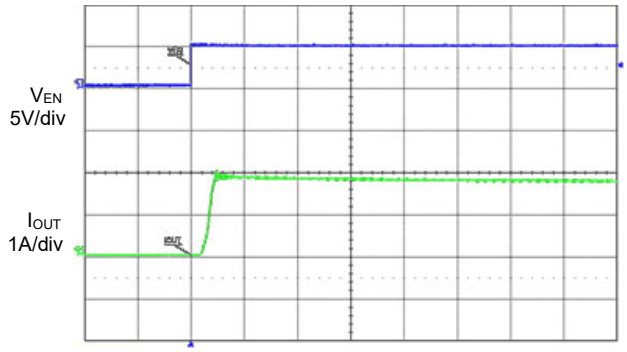
Resistance Load Inrush Response
(C_{OUT}=4.7μF, R_L=1.65Ω)



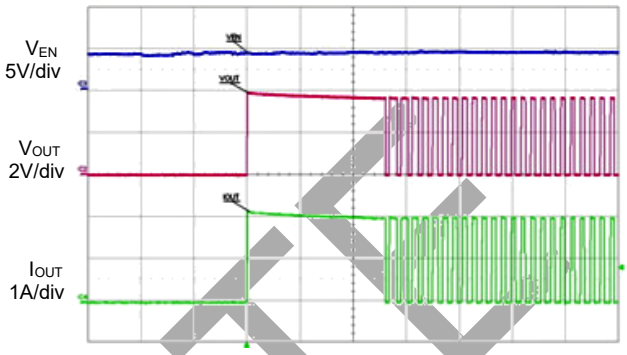
Time 100μs/div

Performance Characteristics (continued)

Short-Circuit Current, Device Enable into Short (V_{IN}=5.0V, C_{OUT}=4.7μF)



Thermal Shutdown Response (V_{IN}=5.0V, C_{OUT}=4.7μF, R_L=1.65Ω)



Ordering Information (Note 3)

AP2821 X X - X

Product Name	Package	Packing	RoHS/Green
	K : SOT-23-5	TR : Tape & Reel	G1 : RoHS Compliant and Green

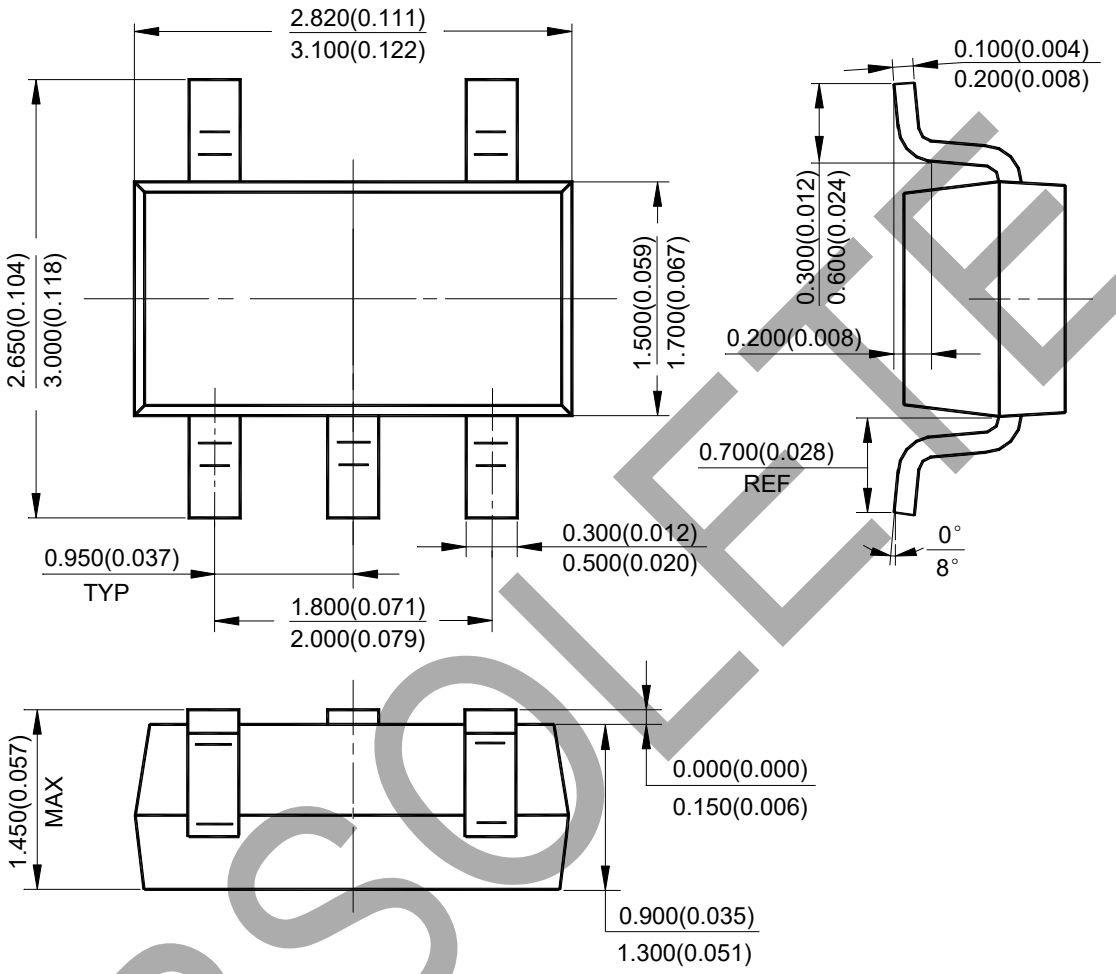
Orderable Part Number	Package	Temperature Range	Marking ID	Packing
AP2821KTR-G1	SOT-23-5	-40 to +85°C	G4E	Tape & Reel

Note: 3. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

Package Outline Dimensions (All dimensions in mm(inch).)

Please see http://www.diodes.com/package-outlines.html for the latest version.

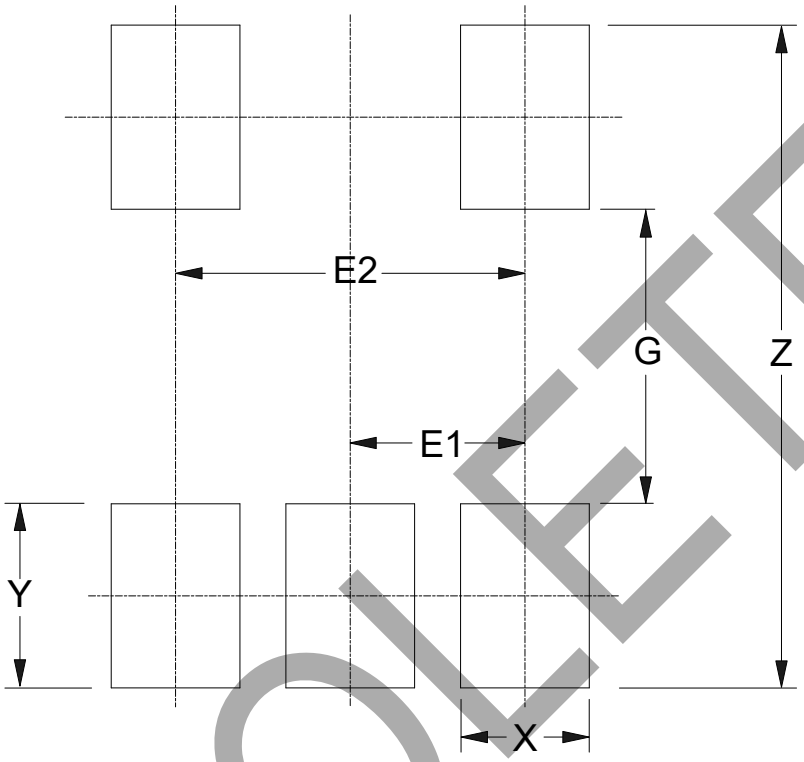
(1) Package Type: SOT-23-5



Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: SOT-23-5



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E1 (mm)/(inch)	E2 (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037	1.900/0.075

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